

REVIEW

Microchips and their Significance in Isolation of Circulating Tumor Cells and Monitoring of Cancers

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Abstract

In micro-fluid systems, fluids are injected into extremely narrow polymer channels in small amounts such as micro-, nano-, or pico-liter scales. These channels themselves are embedded on tiny chips. Various specialized structures in the chips including pumps, valves, and channels allow the chips to accept different types of fluids to be entered the channel and along with flowing through the channels, exert their effects in the framework of different reactions. The chips are generally crystal, silicon, or elastomer in texture. These highly organized structures are equipped with discharging channels through which products as well as wastes of the reactions are secreted out. A particular advantage regarding the use of fluids in micro-scales over macro-scales lies in the fact that these fluids are much better processed in the chips when they applied as micro-scales. When the laboratory is miniaturized as a microchip and solutions are injected on a micro-scale, this combination makes a specialized construction referred to as “lab-on-chip”. Taken together, micro-fluids are among the novel technologies which further than declining the costs; enhancing the test repeatability, sensitivity, accuracy, and speed; are emerged as widespread technology in laboratory diagnosis. They can be utilized for monitoring a wide spectrum of biological disorders including different types of cancers. When these microchips are used for cancer monitoring, circulatory tumor cells play a fundamental role.

Keywords: Microchips - cancer - circulating tumor cells - monitoring

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Introduction

As the genes and proteins are the fundamental components of biological systems, they are considered as central focus of advances in molecular and cellular biology. Recent progresses in genomics and proteomics have led to the advent of high-throughput screening methods such as microchips, or “lab on a chip (LOC) structures, or micro total analysis system (μ TAS) (Figeys and Pinto, 2000). Being adapted to simultaneous analysis of hundreds of different samples (Sato et al., 2002). each comprising variable parameters, the microchips has gained many advantages over macro-scale methods regarding efficiency and affordability (Kartalov et al., 2006). In the last decades with progressive arrival of microchip technology, a body of biochemical and biological experiments has been performed using this technology with remarkable efficacy. Several experiments which are commonly performed by these microchips are listed in Table 1. In fact by the advent

of micro-analyzing methods like HPLC in the past; several revolutionary changes in cellular and molecular biology which demanded high sensitive detectors; the advent of micro-systems and a breakthrough in micro-electronics industry; and finally the desire of human to apply low cost, portable and high-throughput systems for detection of different disorders resulted in the emerging of current high-tech microchips (Whitesides, 2006).

These appealing micro-systems firstly described in 1958 by Jack Kilby, an American electronic engineer, who in 2000 honored by Nobel Prize in physics. Primarily, the system had an elementary structure. Subsequently, more advanced micro-fluidic systems were developed in the form of gas chromatography in 1970. For almost 20 years, these novelties have not attracted many scientists. But since 1990, a wide spectrum of distinct investigations has dedicated in this field of study which revolutionized the science, especially the medical technology. (Dingwall, 1979; Smith, 1984; Holden, 1989; Zubritsky, 1999;

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